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When Disaster Strikes

The Texas Coast has been the setting for some sobering displays of the unbridled violence of natural forces. Indeed, a succession of assorted catastrophes has plagued this locale almost relentlessly. Galveston Island itself suffered one of the most dreadful calamities of this century and witnessed another at close range.

Dealing with misfortune is nothing new for the army engineers. At Galveston, their disaster activities may be traced back to the storm of September, 1875, when Engineer Department employees manned boats and rescued their co-workers stranded at Fort Point and others caught in the raging waters. They have been "on hand" for every crisis since that time, performing a role of growing importance as their special capabilities have led them into new and expanded areas of responsibility.

The most frequent and expectable natural disasters with which the Galveston District must contend are the tropical storms that besiege the coastal region during the months of June through October. One after another, these storms have swept across the Gulf of Mexico and slammed into the vulnerable Texas Coast. During the 105 years from 1871 to 1975, a total of twenty-one hurricanes struck this coastline, leaving behind a trail of destruction and devastation.[1] Because coastal residents tend to become somewhat inured to the equinoctial storms, it took a particularly bitter lesson to convince Galvestonians that major protective works were a vital prerequisite to preservation of their island.

Catastrophe Leads to Seawall Construction

As Galveston ushered in the twentieth century, this city of thirty-eight thousand residents was enjoying prosperity from its bustling port and a host of popular resort attractions. Natural sand dunes, 12 to 15 feet high, which had originally bordered the shoreline and offered some protection to the city, had been removed to allow easy access to the beach. Broadway, Galveston's bastion of conspicuous consumption, was a spacious boulevard boasting a luxuriantly landscaped esplanade flanked by palatial mansions — architectural grandeur reflecting the substantial wealth

Opposite page: Galveston beachfront, 1890

of the city. With an elevation of 8.7 feet above the level of the Gulf, Broadway formed the highest point on the island.[2]

Galvestonians were not unmindful of the need for storm protection. The subject had been tentatively broached on more than one occasion since the founding of the city. Sobered by the obliteration of Indianola on August 19, 1886, a group of thirty businessmen known as the Progressive Association met to discuss the problem and issued a public resolution calling for speedy construction of a seawall. This group obtained from the state legislature an amendment to the city charter, authorizing issuance of bonds to finance protective works; also, the association consulted Capt. James B. Eads, who submitted a plan for a 12-foot embankment. The proposed bond issue met with such widespread opposition that an election to ratify it was never held.[3] The passage of time brought only apathy and inaction. E. M. Hartrick, a former city engineer who later joined the Galveston Engineer Office, offered the timely comment:

> The people of Galveston will go on living in fancied security as they always have.[4]

And so they did, until the unforgettable weekend of September 8-9, 1900. With nothing more than some abortive attempts to provide protection, Galveston sat utterly undefended against the elements. By all measures a disaster of unprecedented destruction, the 1900 storm looms unmistakably as the awesome milestone in the city's history.

Preceded by a couple of days of rough waters in the Gulf and abnormally high tides, Saturday, September 8 dawned on bay waters showing a 5-foot elevation. During the morning, a gale from the north gradually pulled itself eastward and grew in intensity until, by noon, it resembled the winter "northers" in strength and direction. A slanting rain fell upon the city. Along the beachfront, brightly painted bathhouses and wooden tourist piers built out over the water became the first structural victims of the storm as the waters rose and the angry waves smashed against their pilings.[5]

By mid-afternoon, the monstrous storm was heading into its most horrendous hours. At the Weather Bureau Office in the Levy Building, the rain gauge blew away, followed sometime thereafter by the anemometer. Although no actual measurements document maximum velocity, wind speed has been estimated at 120 miles an hour. The slow rise of the tide, only a foot between 6:00 A.M. and 2:00 P.M., had been deceptive. With sudden swiftness, the waters began encroaching upon the city, soon enveloping it as the tide climbed to a height of 8.5 feet at 5:30 P.M. By this time, those unfortunate persons stranded downtown who had struck out

for their homes were literally swimming down Broadway, clutching at wrought iron fences, trees, or any other stationary objects that might prevent them from being washed away. Heroic accounts describe people riding out the storm in the upper limbs of sturdy trees and drifting through the night on floating pieces of roofs, cisterns, and other fragments of formerly intact structures. At 7:30 P.M., as the force of the wind moved towards its peak, the inundation was complete; the water had reached an elevation of 14.5 feet above mean low tide.[6]

By 10:30 P.M., the storm fury began to subside and the waters had receded to about 7 feet, but the more macabre part of the nightmare was just beginning.[7] The devastation left in the wake of the storm was staggering. For days, the stunned survivors went about the grim business of searching through debris. Remnants of humanity were strewn across the island. On Tuesday, September 11, the *Houston Post* estimated the human toll conservatively at eighteen hundred to two thousand. The following day, the paper's banner carried the loss at five thousand lives. On September 14, the *Post* published the names of twenty-seven hundred people who had perished in the disaster. No one will ever know exactly how many lives were extinguished by the storm; although some estimates soar as high as eight thousand, the most tempered and generally accepted figure remains somewhere above six thousand.

Cut off from the rest of the outside world, the homeless and bereaved survivors faced added trials. The struggle for mere existence was complicated by lack of shelter, provisions, and suitable drinking water. Destruction of the gas works and loss of electrical power further intensified the problem. Looting broke out to an extent that necessitated placing the city under martial law.

In shock, the citizens of Galveston viewed the tragic scene that surrounded them and reckoned their losses. Property damage amounted to $25 million. Debris from more than thirty-six hundred demolished houses blanketed the city. Destruction along the beachfront was total, the area south of Broadway having sustained the worst of the storm. In some places along the shoreline, up to 300 feet of beach had been lost by erosion.[8]

The Galveston Engineer Office suffered its share of the losses: plant was badly damaged, records were lost, and many stations used as points of reference for surveys were obliterated. After the storm, the army engineers ran a system of levels to ascertain the height of the overflow. They recorded the greatest height of the flooding, 16.4 feet, at Battery Croghan on the Fort San Jacinto reservation.[9]

Galveston citizens addressed themselves to the unfathomable task of rebuilding the shambles that lay about them. They began by revamping

Debris barrier created by Galveston storm, 1900 (Photograph by H. H. Morris)

Port side of city after 1900 storm, looking east from Fourteenth Street and Avenue A. Note scour under railroad tracks. (Photograph by H. H. Morris)

Debris dominates this view looking west from Thirteenth Street and Broadway. (Rosenberg Library)

Looking southeast from Twelfth Street and Avenue I, 1900 (Rosenberg Library)

their municipal government, introducing the city commissioner system which became known as the "Galveston Plan."[10]

On November 22, 1901, the new city commissioners charged a board of three engineers to plan:

1) The safest and most efficient way for protecting the city against overflows from the sea;

2) elevating, filling, and grading the avenues, streets, sidewalks, alleys, and lots of the city so as to protect it from overflow . . . , and to secure sufficient elevation for drainage and sewerage;

3) and, a breakwater or seawall of sufficient strength and height to prevent overflow of and damage to the city from the Gulf.[11]

Chairing the three-man board, Brig. Gen. Henry M. Robert had been named chief of engineers on April 30, 1901 and had retired from military service on May 2 of that year.[12] This fascinating gentleman had already achieved immortality through the publication in 1876 of a slim volume, dear to the heart of every parliamentarian, entitled *Robert's Rules of Order*. His service as division engineer of the Southwest Division had occasioned numerous visits to Galveston in conjunction with river and harbor improvements and fortification construction. Also thoroughly familiar with the island, Henry Clay Ripley brought to this board engineering experience along the Texas Coast dating back to the early 1870s, when he conducted the first survey for the gabion jetties. The third member of the board was another civilian, Alfred Noble.

Submitted on January 25, 1902, the Robert Board plan called for construction of a solid concrete wall, rising 17 feet above mean low tide. This structure would extend more than 3 miles: from the south jetty near Eighth Street to Avenue D and Sixth Street, along which it would continue across the island to the Gulf, and southwest along the beach to Thirty-ninth Street. The city grade would be raised with a rise of 1 foot every 1,500 feet from the bay to the Gulf. Beginning with 8 feet at Avenue A, graduating to 10 feet at Broadway, and 12 feet at Avenue P, the elevation would culminate in an 18-foot embankment at a distance of 200 feet from the seawall.[13]

Aided by relief funds that had poured into the stricken city after the storm, Galveston County constructed this portion of the seawall between October, 1902 and July, 1904 at a cost of $1,581,673.30. The curved concrete wall, 17,593 feet long, was erected upon a pile foundation. The design deviated from the Robert Board plan only in that the embankment

Brig. Gen. Henry Martyn Robert (National Archives)

Picture of original Galveston seawall by artist Julius Stockfleth in 1904 was reproduced as a postal card. (Rosenberg Library)

behind the wall was built to a maximum height of 16.6 feet with a width of 100 feet.[14] In other words, the county embankment sloped down from the seawall rather than rising up above it as the board had specified.

A seawall of similar design was authorized by Congress to protect the federal investment in the port and in the military reservation at Fort Crockett. So that the original county seawall and the new Fort Crockett extension might furnish continuous protection along the Gulf from Sixth to Fifty-third streets, the private and city property lying between Thirty-ninth and Forty-fifth streets was deeded to the United States. The Fort Crockett seawall extension, 4,935 feet long, was constructed between December, 1904 and October, 1905 at a cost to the United States of $295,077. In all, the sum of $750,000 was appropriated to finance seawall construction and filling the enlarged reservation up to a grade of 18 feet.[15]

The first test of the seawall, a hurricane on July 21, 1909, served as an object lesson for Galveston County. Although storm tides rose only about 6.6 feet above mean low tide, considerable quantities of water splashed over the seawall. The modifications made by the county caused the storm waters to drain across the fill into the city rather than back into the Gulf as the Robert Board plan had intended. The county embankment suffered severe scouring; in contrast, where the 200-foot-wide embankment rose to 18 feet at Fort Crockett, the protection for the fill proved adequate. The damage sustained by the county embankment convinced the county to repair and alter its embankment along lines of the original proposal.[16]

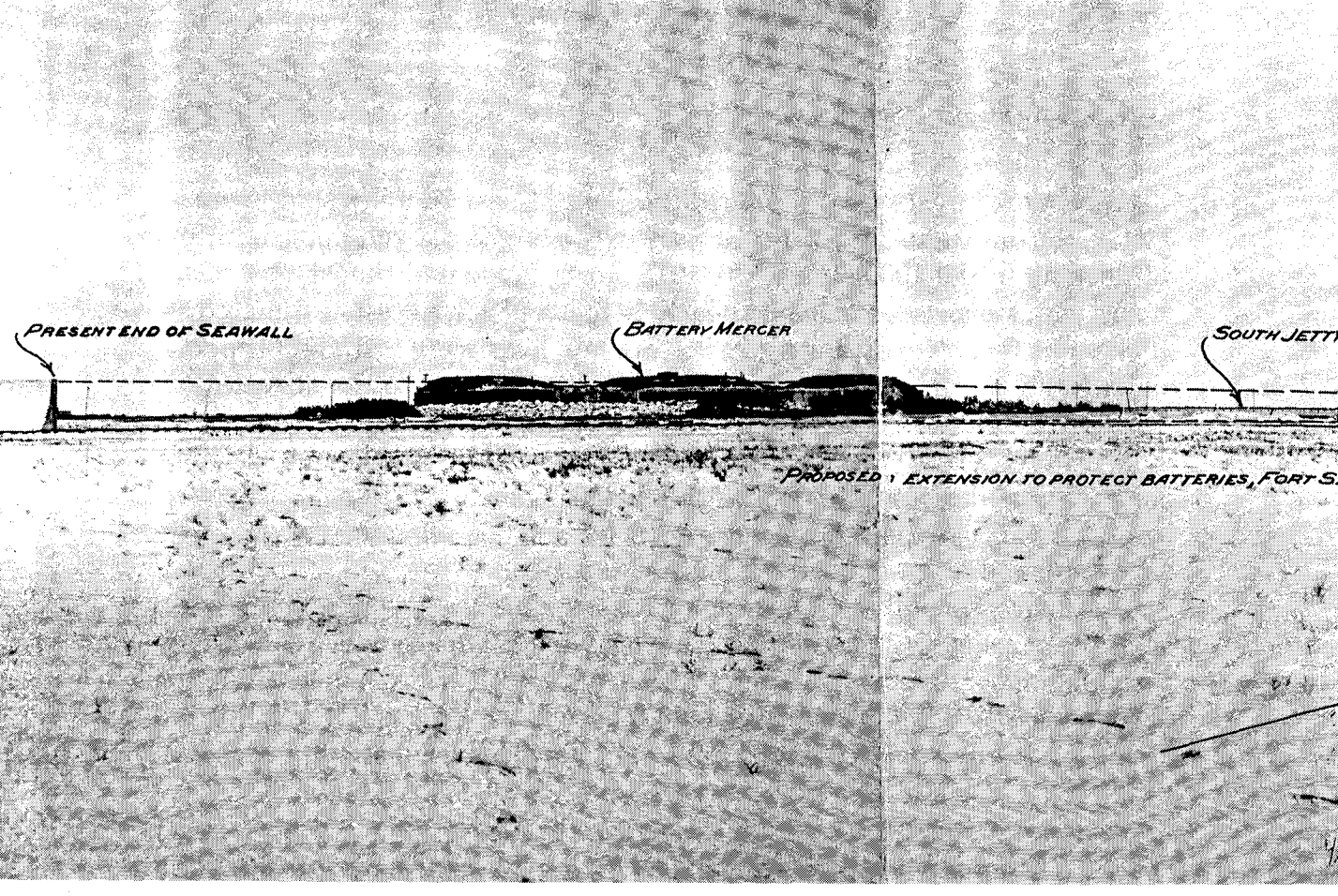
A far more severe storm crossed the Texas Coast 26 miles southwest of Galveston on August 16, 1915. Greatly exceeding the seven-hour duration of flooding in the 1900 storm, the 1915 storm inundated the city for forty hours with storm tides reaching nearly 14 feet and wave crests estimated as high as 21 feet. Nevertheless, relatively few lives were lost and property damage amounted to $4.5 million, significant contrasts to the devastation left by the 1900 storm. The seawall successfully withstood its first major trial. This concrete structure received no injury other than two small chips near Thirty-ninth Street, where the furious waves had flung a schooner over the wall, catching the anchors on its toe and pounding the vessel above into scattered fragments of hull, masts, and cargo.[17]

An eroded embankment once again represented the savage storm's most significant casualty, but this time the destruction was far more extensive, reaching almost the entire length of the seawall. Reconstructed after the 1909 storm to a 19-foot elevation 200 feet from the seawall, the embankment was badly scoured and the pavement destroyed completely between Sixth Street and Eighteenth Street. Only the section between Eighteenth and Twenty-first streets was spared by the additional protection afforded by buildings along that stretch. The 1915 storm also took its toll in front of the seawall, where as much as 300 feet of beach completely disappeared.[18]

Galveston County asked General Robert to review the problem and devise a plan to furnish further hurricane protection. His recommendations promptly led to widening the pavement behind the seawall to 100 feet, installing at that point a reinforced concrete sheet pile cutoff wall, raising the embankment to a top elevation of 21 feet at a distance 200 feet from the seawall, and adding at the crest a smaller concrete bulkhead, 1 foot thick and 5 feet high.[19]

If ever a man deserved to feel a storm cloud hovered over his head, it was Lt. Col. Charles S. Riché, whose first tour of duty in Galveston had

Damage to seawall embankment at Sixth Street from 1915 storm

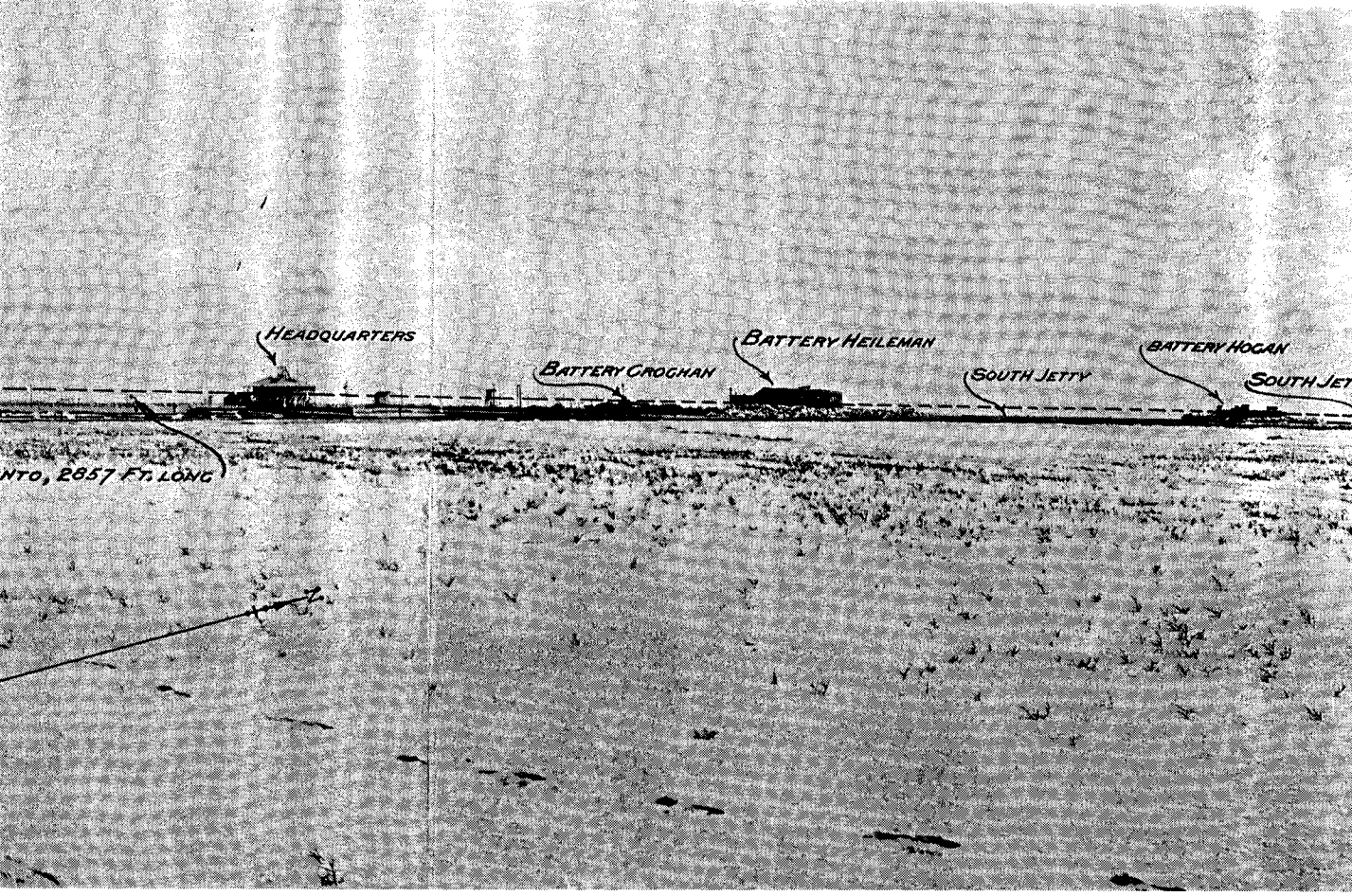


been marked by the Spanish-American War and whose second assignment there was punctuated by the 1900 disaster. During the 1915 storm, Colonel Riché occupied the helm of the Galveston District for the third and final time. After this last of the storms he would weather at Galveston, he again inspected damage inflicted upon the fortifications, channel, and harbor.

Riché found the batteries at the unprotected Fort San Jacinto structurally intact and mainly impaired by salt water that had saturated the electrical equipment. Wooden barracks and other light structures on the reservation, including the Engineer Department depot at Fort Point, were destroyed. Most alarming, however, was the fact that small channels cut up the surface of the ground in the reservation. These were particularly noticeable between the various batteries where currents had been concentrated and the scour intensified.[20]

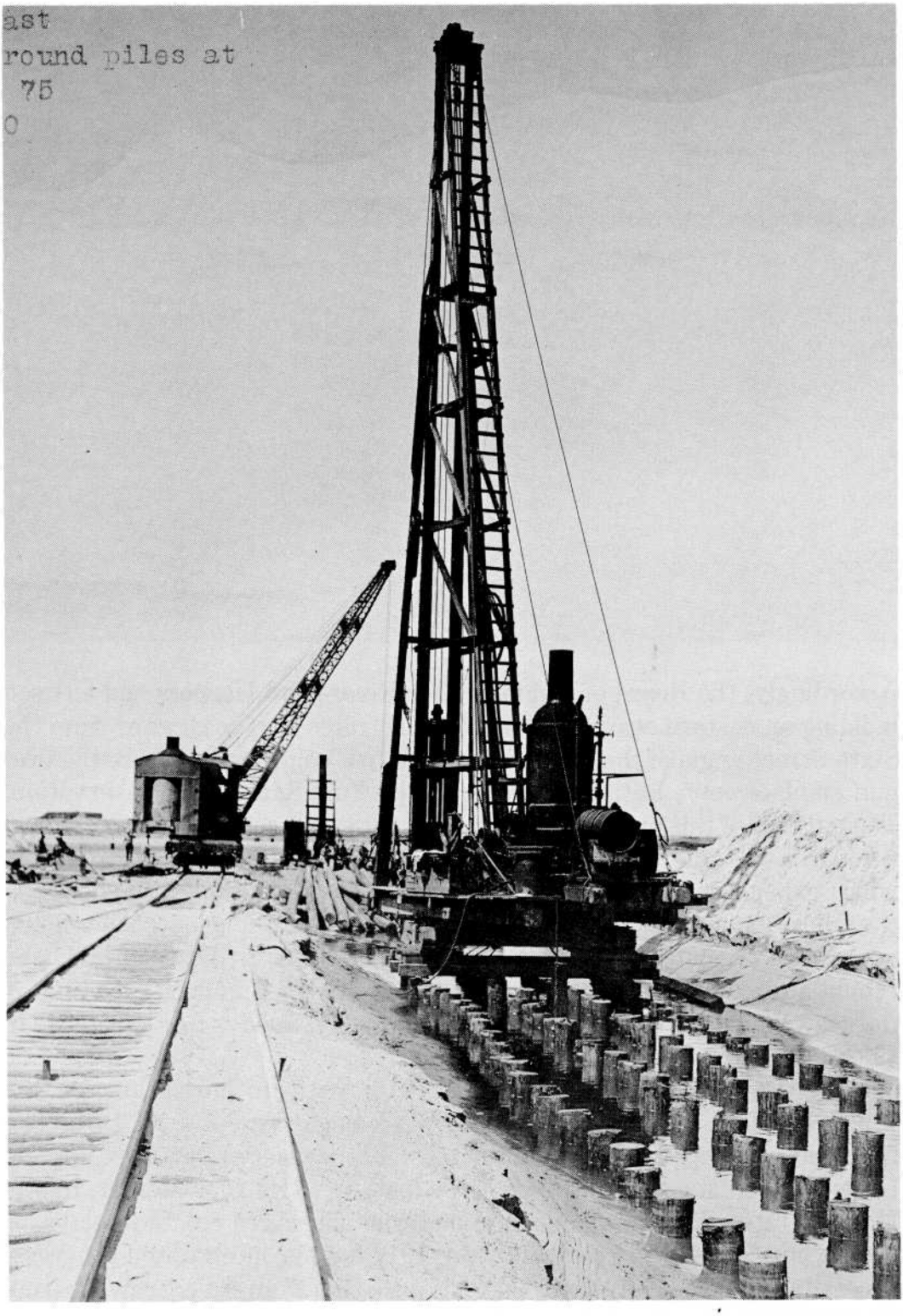
The 1915 storm underscored the point made by a special board of engineers early in 1913:

> The special board invites attention to the advisability of protecting the narrow neck between the city of Galveston and Fort San Jacinto. It believes that in time of great storm this neck may be breached, resulting in serious damage to the Galveston Channel.[21]

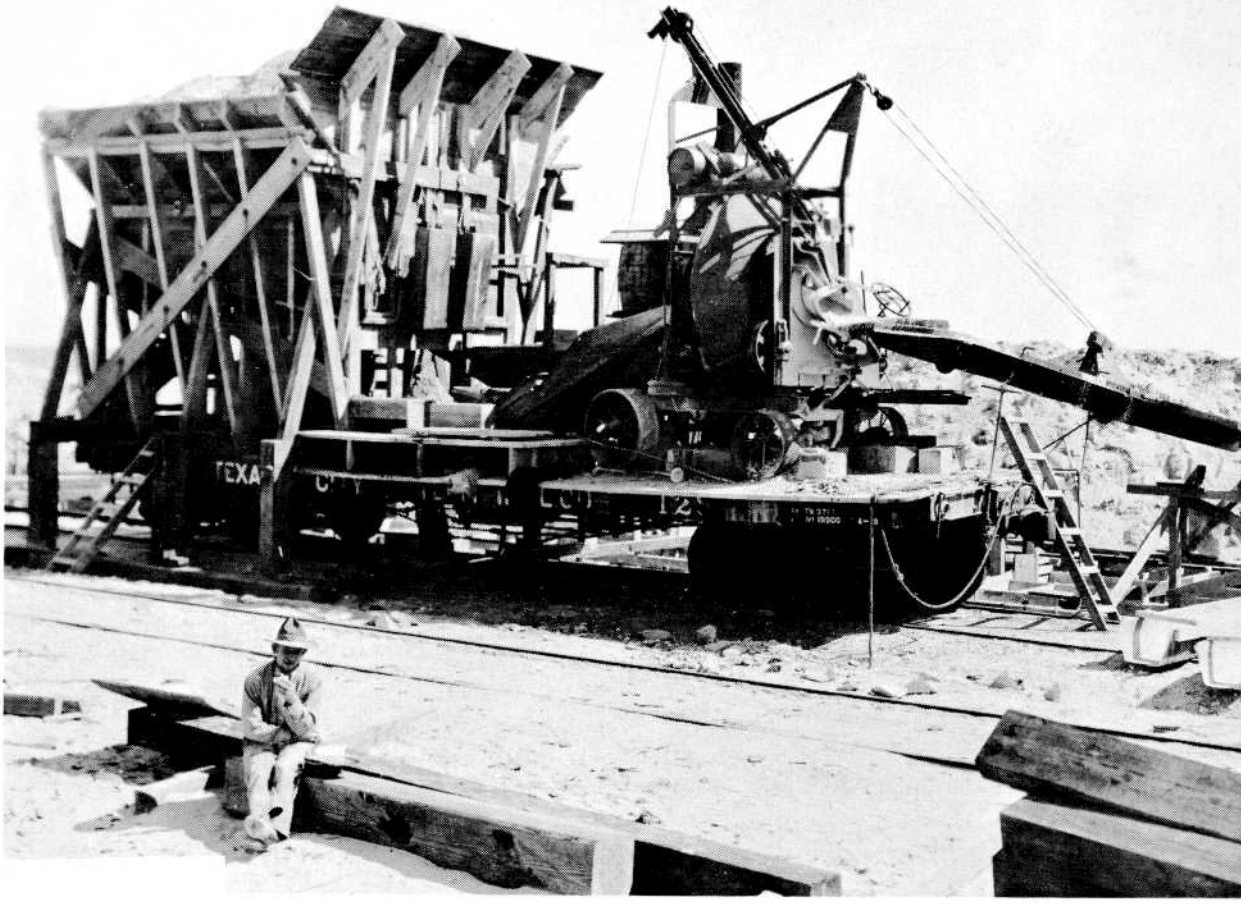


Accordingly, the Board of Engineers for Rivers and Harbors had advised building an eastern seawall extension, to stretch northeastward from the Sixth Street angle of the county structure to a point just opposite the first gun emplacement, Battery Mercer, on the Fort San Jacinto reservation. The purpose of this extension was to prevent endangering the ship channel through a possible breach in the shore arm of the south jetty, to enable wharf expansion, and to preserve the integrity of communication between the military reservation and the city. This 10,300-foot-long extension would not protect the batteries at Fort San Jacinto. These fortifications had been rebuilt after 1900 to withstand open exposure to the Gulf until such time as the seawall would be extended to the south jetty, an idea first advanced in 1902.[22]

Congress responded on July 27, 1916, with authorization for the 10,300-foot-long eastward extension. Work began on June 20, 1918. The first 3,300 feet, up to the boundary of the military reservation, were built by the local interests; the remaining 7,000 feet, up to Battery Mercer, by the United States. Wartime labor and material shortages created delays. A severe hurricane on September 13-14, 1919 further interrupted progress, necessitating some refilling of the "Atlantic Hole," an old borrow pit from which material had been removed for the city grade raising and which had been scoured badly by the storm. In March, 1921, this portion of the eastern extension was completed.[23]

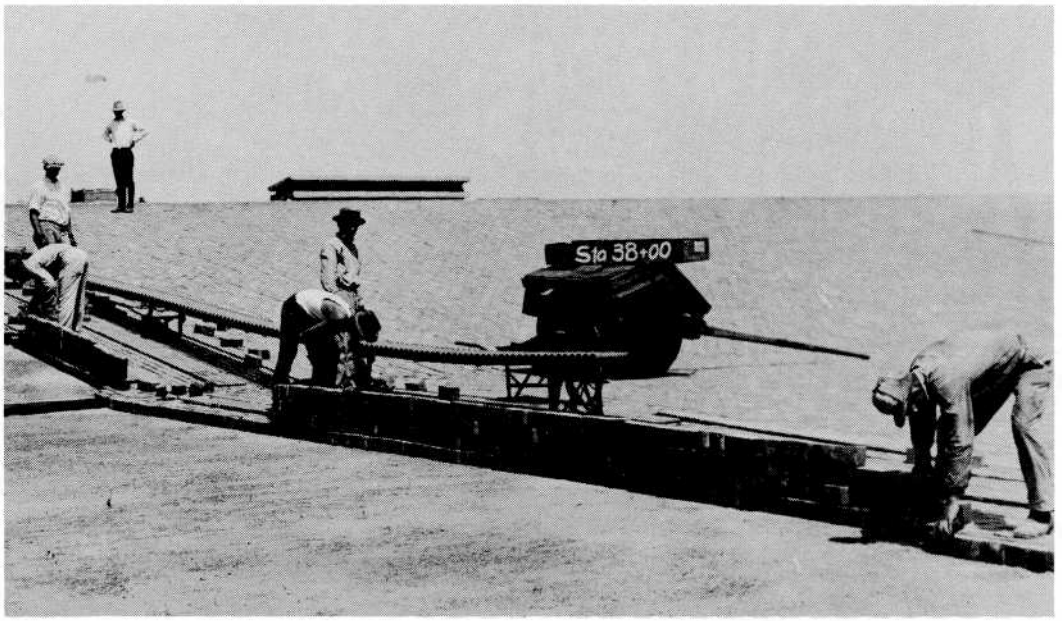


East end seawall extension. Pile driver placing round wooden piles, May 17, 1920



Small concrete mixer moved along railroad tracks to pour concrete into base for east end seawall extension.

Huge steel forms, designed by Galveston District engineers, into which concrete was poured for east end seawall extension, 1920



Laying brick pavement in Fort San Jacinto portion of east end seawall extension, April 23, 1925

The 1919 storm had reiterated the hazardous plight of the San Jacinto reservation as well as the danger of not extending the seawall to the south jetty. Properly protected and filled, Fort San Jacinto would provide nearly 800 acres suitable for future military use. The final extension eastward, 2,860 feet, was authorized by Congress on September 22, 1922. Bordering the military reservation and terminating at the south jetty, the district accomplished this construction using hired labor between May, 1923 and January, 1926. The design for the reservation embankment differed from the earlier ones, rising for a distance of 100 feet from the wall to a 26-foot-high, 8-foot-wide crest that was bulkheaded by a concrete cutoff wall. Material dredged from the ship channel furnished much of the fill for the reservation.[24]

Located at the eastern end of Galveston Island, the city had no alternative but to grow westward. Galveston County completed a 2,800-foot-long seawall extension from Fifty-third Street to Sixty-first Street in June of 1927, but city expansion continued beyond its western extremity. To protect the newly developed area, Congress authorized a 16,300-foot-long extension from Sixty-first Street west in 1950. Because the Korean Conflict delayed federal funding for this 3-mile extension, Galveston County went ahead and constructed the first mile between 1951 and 1953 at a cost of $2,870,000. The United States began construction of the remaining 2 miles in 1958, completing the 10-mile-long seawall by 1963 at a cost of $6,465,000.[25]

"An Unavoidable Accident"

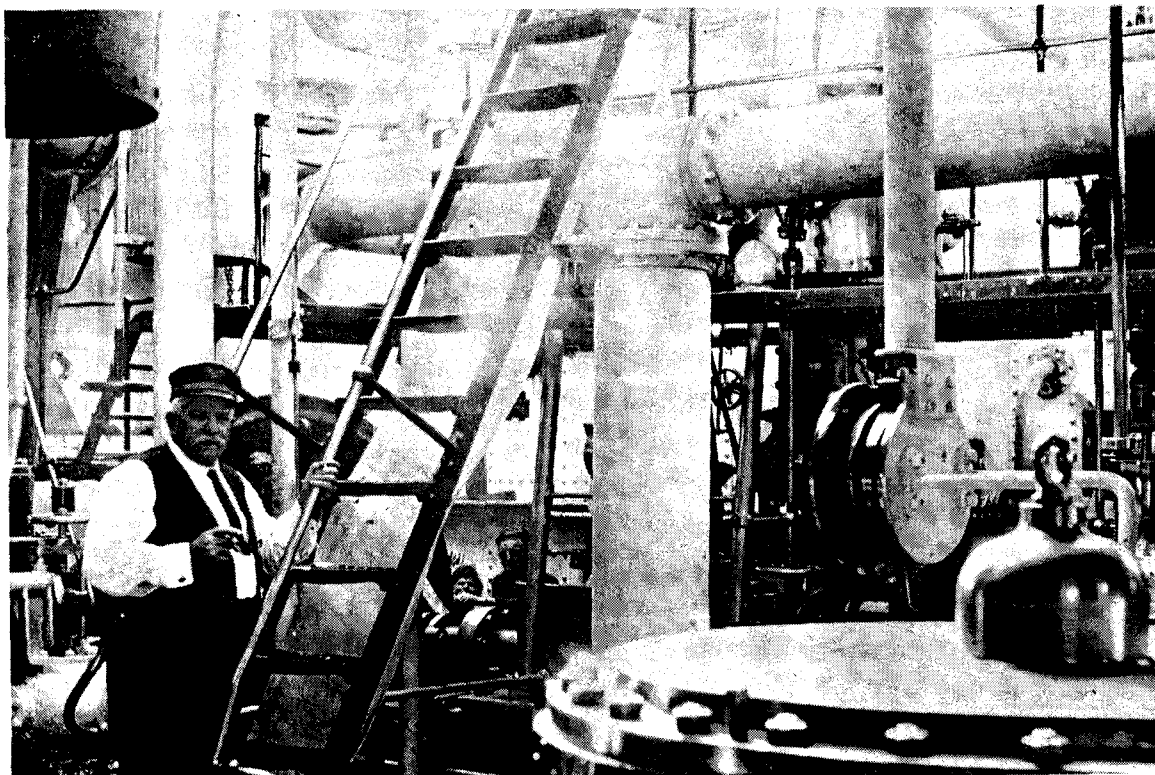
Successful in reducing storm damages on the island, the seawall still cannot eliminate such destruction altogether. One hurricane that occurred in 1943 remains a vivid memory for many Galveston District personnel. A set of unusual circumstances conspired to cause disastrous loss of lives and plant.

The storm itself was out of the ordinary, arising suddenly and not far off the coast. Wartime restrictions limited radio and telegraphic communication along the coast and censored the publication and broadcasting of weather forecasts. These conditions added up to gross underestimation of the atypical storm's intensity plus confusion, if not total ignorance, of its anticipated time of landfall.

An experienced veteran of the Galveston District, the seagoing hopper dredge *Galveston* was at work in the Galveston Entrance Channel, dredging in the vicinity of Bolivar Roads. Built at a cost of $381,574.05, this steel-hulled vessel had been delivered to the district on November 12, 1908 and was valued at $2.5 million in 1943.[26]

The first advisory regarding the storm was delivered by launch to Capt. Emil Laine, master of the dredge, around mid-afternoon on Monday, July 26. Before 8:00 P.M., he had anchored his ship inside Bolivar Roads at the same place where she had ridden out the 1915 hurricane when he was

Captain Prendergast, in engine room of U.S. hopper dredge Galveston. *Prendergast served as inspector for the vessel's construction and later became her first master.*



Capt. Emil Laine

serving as first mate. Had he known twenty-four hours in advance that a hurricane was in the offing packing winds of at least 104 miles per hour, he might have taken the vessel to the more protected waters of the Houston Ship Channel; however, for a storm of the magnitude predicted, "a small tropical disturbance of slight but possibly increasing intensity" with "strong winds 30 to 40 miles per hour," his precautions were appropriate.[27]

Tuesday, July 27 dawned with no sign of malignant weather. Those Galvestonians who were aware of the advisories issued the previous day assumed the storm had hit land during the night and that the threat had passed. After a second advisory Monday afternoon predicting winds of 50 to 60 miles per hour, no further advisories had been received and the citizens of Galveston went about business as usual.[28]

Attempts by district personnel to contact the Weather Bureau on Tuesday morning failed; telephone connections could not be made. Around 9:30 A.M., high winds arose, accompanied soon thereafter by heavy rainfall. Electric power went off and telephones ceased to function. That a miscalculation had been made was obvious by 10:00 A.M. By noon, the full fury of the storm swept inland, paralyzing the island city for the next couple of hours. Abruptly, the winds increased in velocity and shifted to an eastward course.[29]

Presumably, the sudden change in wind direction caused the anchors of the *Galveston* to trip. Between noon and 2:00 P.M., the dredge drifted a considerable distance, propelled stern first by the high wind, heavy seas, and a strong ebb tide. The men on board, hampered by negligible visibility, were unaware that the vessel had moved from its mooring until 2:45 P.M. when they sighted the north jetty about 150 feet off the starboard side of the dredge. Despite frantic efforts to steer clear, the *Galveston*

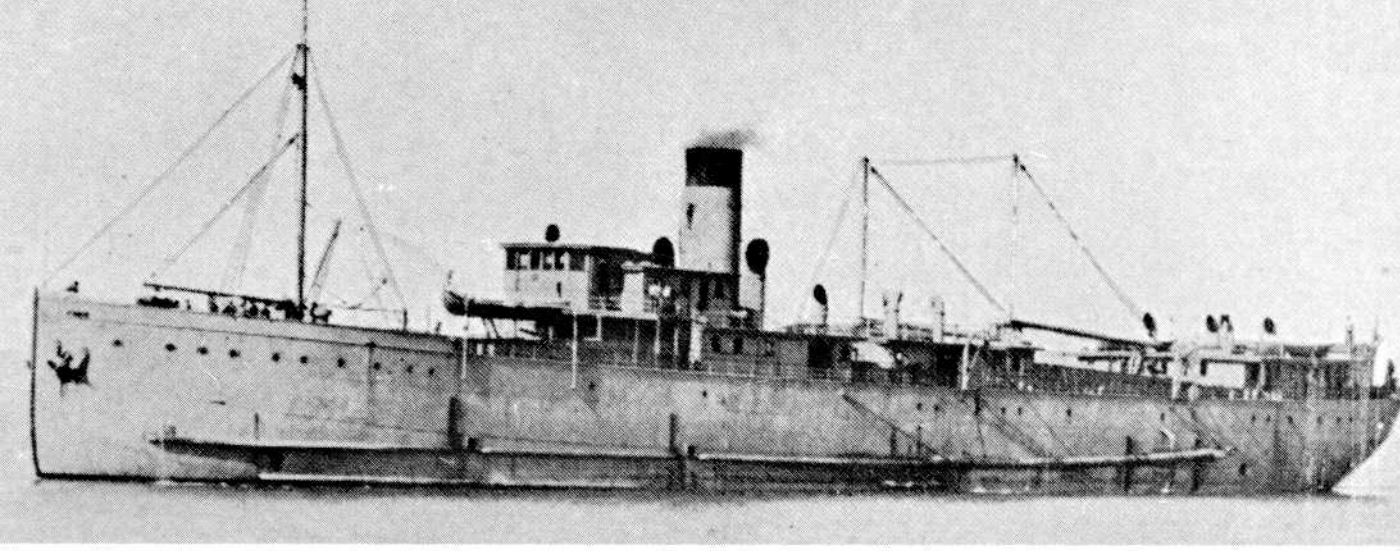


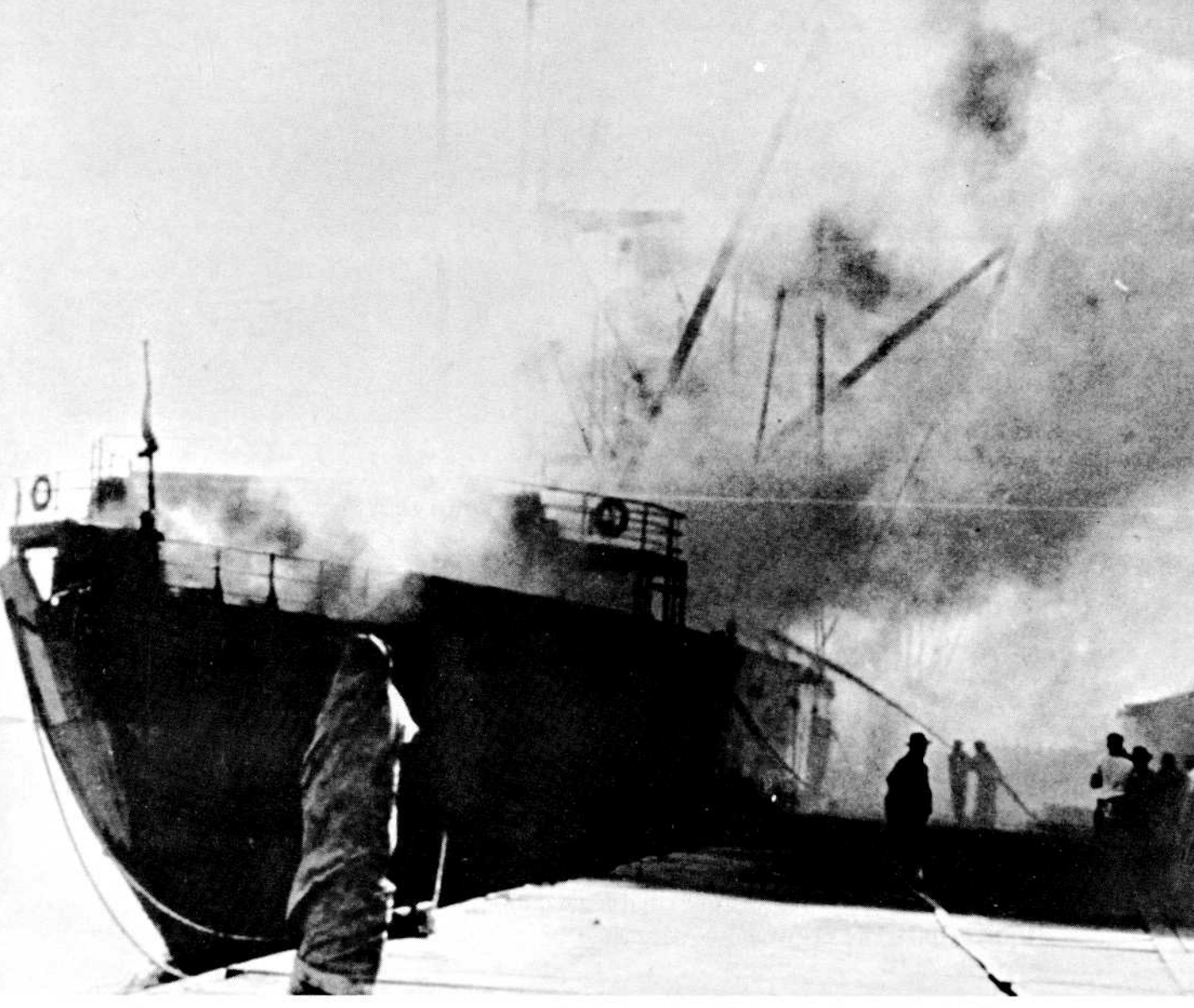
Plate of new dredge Galveston *as she appeared in 1909* Annual Report of the Chief of Engineers

struck the rocks about five minutes later, puncturing her hull and immediately taking in water. Crew members moved up to the top deck for safety.[30]

Because of the interrupted telephone service, District Engineer Col. Wilson G. Saville did not learn of the wreck until 8:30 P.M. on Tuesday. He arranged with the Coast Guard to attempt to rescue the crew that night. Shortly after midnight, Colonel Saville and two other district employees, Herbert Schmidt and Basil O'Brien, arrived at the dredge. Inspecting the damaged vessel by searchlight, they found the pilot house and bridge deck intact and above water. Unable to maneuver their boat close enough to evacuate the crew, however, they postponed rescue operations until daybreak.[31]

As the long night wore on, the force of the heavy seas proved more than the dredge could withstand. Some time before 3:00 A.M. Wednesday, the superstructure began to disintegrate; all but the smokestack and the masts was washed away. Older and physically disabled crew members set off for the jetty in the only lifeboat that remained intact. The rest of the men abandoned ship on orders from the captain, following an unsuccessful attempt to secure a line from the sinking vessel to the jetty. Most of the men clung to the jetty until daybreak when they were rescued; others were cast adrift and managed to reach the Bolivar shore; one man was found clinging to the smokestack; another washed up on shore, alive, Thursday afternoon. Of the sixty crew members aboard, eleven lost their lives. Captain Laine, who could not swim, went down with his ship.[32]

A board of officers appointed to investigate the sinking of the *Galveston* concluded that it was "an unavoidable accident due to an Act of God." A little after two months after the storm, the government relaxed weather data restrictions, justifying the changes on "improved defense and other war conditions."[33]



French freighter Grandcamp *burning at Texas City dock, just before she exploded, April 16, 1947 (AP Wirephoto, Courtesy of* Galveston Daily News*)*

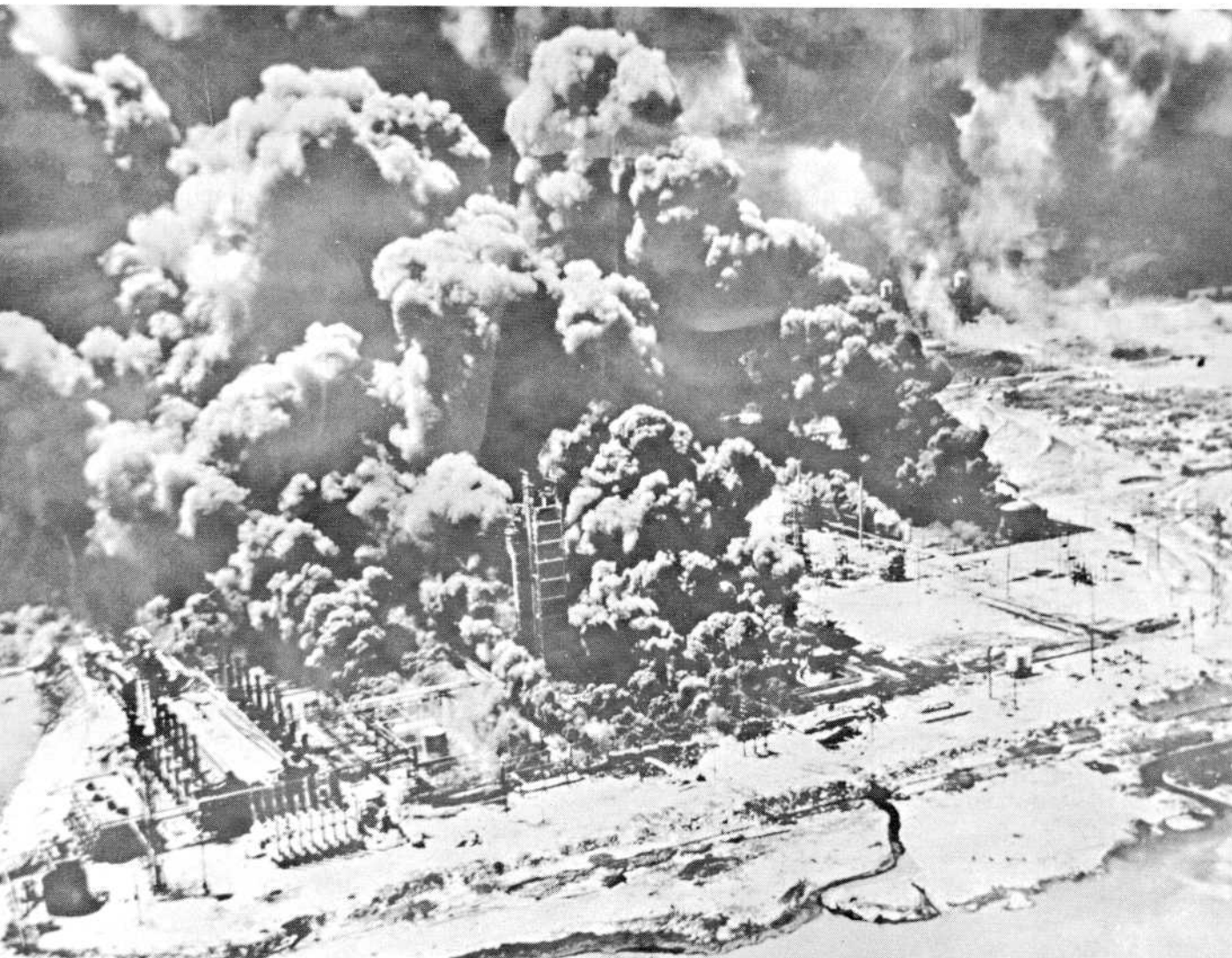
On Hand for a Holocaust

Preparedness of the Galveston engineers, conditioned by repeated experiences with hurricanes as well as wartime operations, was well demonstrated by their response to a somewhat different type of emergency. Shortly after 9:00 A.M. on April 16, 1947, a cargo containing almost twenty-four hundred tons of ammonium nitrate exploded aboard the SS *Grandcamp*, docked at Texas City. Vibrations from the explosion were so intense that personnel at the Port Arthur Area Office, 65 miles away, felt their impact. The initial blast triggered a series of further explosions in the Monsanto Chemical Company area, producing immediate havoc along the Texas City waterfront. Because of the overwhelming heat and wreckage generated by the explosion, a second ship, the SS *High Flyer*, also

loaded with ammonium nitrate, could not be removed from the dock area. At about 1:15 A.M. on April 17, this ship also exploded, adding more horror to the blazing nightmare that resulted in over five hundred deaths, thirty-five hundred injured persons, and property damage estimated between $50 million and $90 million.[34]

Promptly after the first explosion, Galveston District Engineer Col. D. W. Griffiths and other engineer personnel set out aboard two launches for the scene of the disaster. Still other personnel from the repair yard and plant facilities at Fort Point sped toward the mainland by automobile. They reached the City Hall at Texas City by 10:00 A.M. and immediately set up radio communication through a mobile radio unit. Shortly thereafter, Colonel Griffiths and his staff landed at the Texas City Dike, "requisitioned transportation from a passing motorist," and arrived at the City Hall to organize relief operations. Griffiths contacted the commanding officer at Fort Crockett, reporting the seriousness

Explosions set industrial area ablaze. (Courtesy of Galveston Daily News*)*



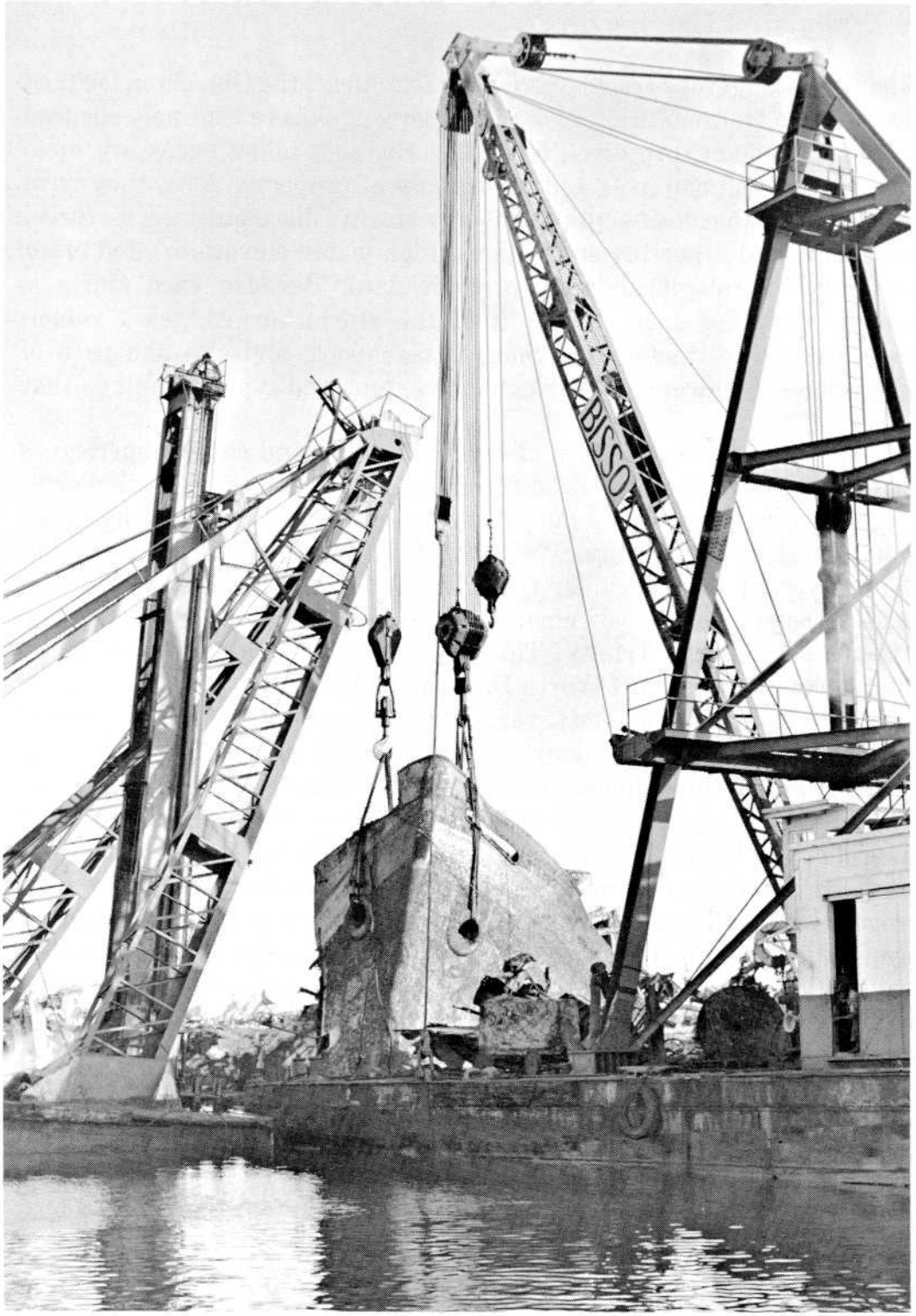
Texas City evacuated except for rescue and relief workers. Burning industrial area in background, April 17, 1947 (AP Wirephoto, Courtesy of Galveston Daily News*)*

of the disaster and making an urgent appeal for medical aid from the Fourth Army.

From noon until 4:00 P.M., all available pickup and carryall trucks, loaded with fire-fighting equipment, first-aid supplies, blankets, mattresses, and sheets, were used for relief activities. Corps personnel were assigned many duties including removing the dead and injured, operating motor pool vehicles for emergency transportation within the Texas City area, and setting up kitchens and feeding fire fighters and evacuation crews when the Fourth Army field kitchens arrived unmanned. Throughout the duration of the daylight hours, the launches *Ralph Millis*, *Guyer*, and *Galvez* and the tug *Wilcox* patrolled the water searching for injured and dead victims of the fire.

Late in the afternoon of April 16, Gen. Jonathan M. Wainwright, commanding general of the Fourth Army, arrived in Galveston and placed the Fourth Army relief services at the disposal of local civil authorities. Fourth Army emergency headquarters were established at Fort Crockett at 4:00 P.M., after which Galveston District personnel continued relief activities under the direction of the Fourth Army and local authorities.

On April 17, the second day of the holocaust, sporadic ignition of oil tanks compounded the confusion. Galveston army engineers made fathometer surveys in the Texas City turning basin and channel in anticipation of the tremendous task, yet to come, of clearing the debris from the channels. District personnel maintained radio communication and held in readiness land and water transportation facilities to dispatch supplies and equipment, continuing rescue and relief activities until April 23. Operations to restore the waterway for navigation were carried on through the following months.



Raising freighter Wilson B. Keene, *completely demolished by explosion from a nearby boat early April 17, 1947*

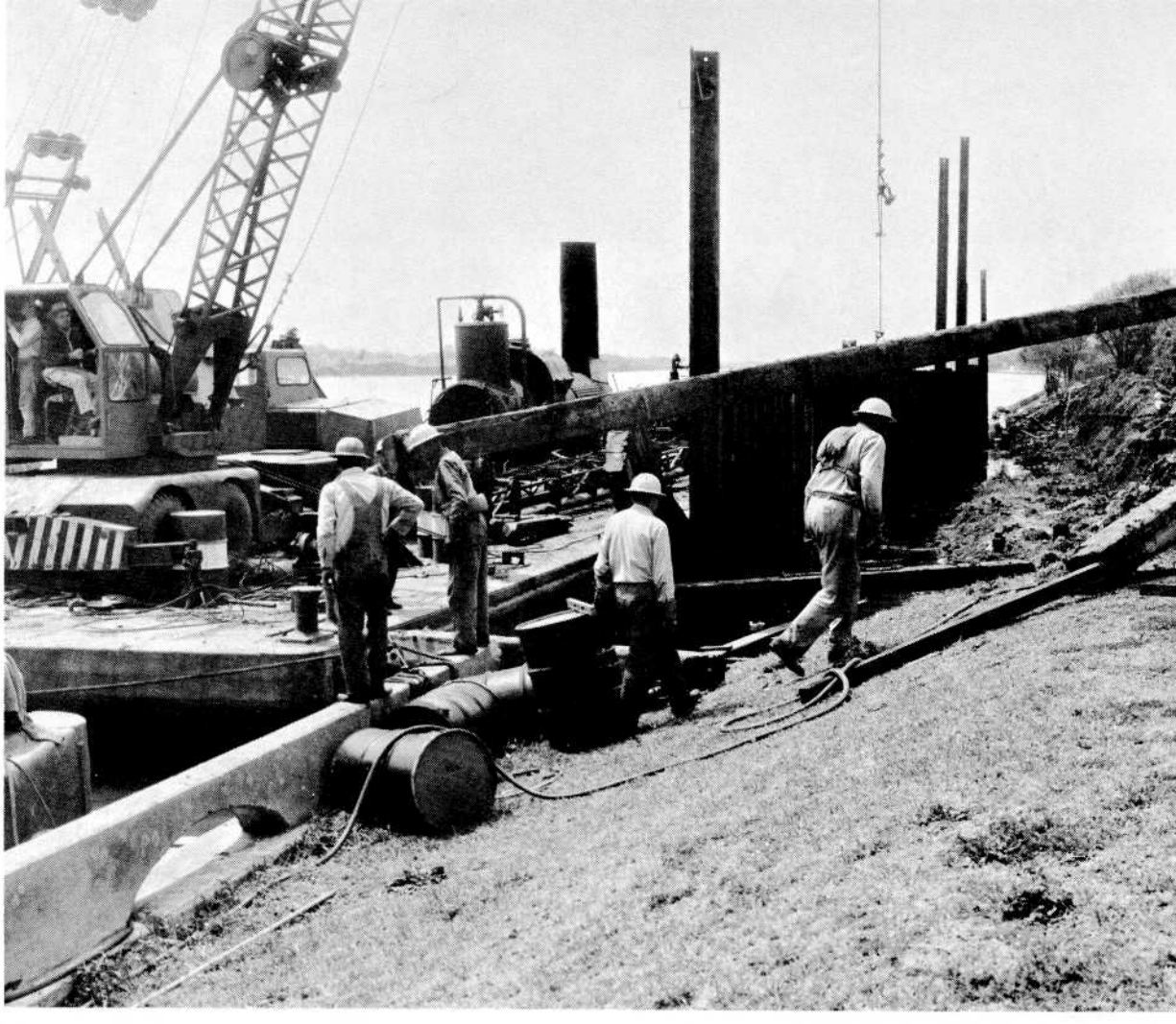
Hurricane Operations

Whenever dangerous storms have been imminent, the Galveston District has mobilized automatically. Engineer personnel have routinely secured government plant, protected federal works, and taken necessary measures to save human lives and reduce loss of property. Also, they have provided valuable documentation of each storm's distinguishing features, measuring and reporting storm tides, high-water elevations, and other pertinent hydrologic and meteorologic data. Because each storm is unique, variables such as height of the storm surges, wind velocities, amounts of rainfall, spawning of tornadoes, and size and path of the cyclone significantly determine the extent and type of damage that will result.

Corps activities in the face of severe flooding and coastal hurricanes have been gradually formalized through a succession of legislative acts. Explicit authority to carry out "rescue work" and to repair "any flood-control work threatened or destroyed by flood" was contained in the Flood Control Act of 1941.[35] Under this and subsequent legislation, the Galveston District undertook emergency levee repairs along flood-prone streams such as the Trinity. This activity diminished somewhat after establishment of the Fort Worth District in 1950.

The 1941 act was amended several times, but essentially it limited army engineer activities to rescue operations during a storm and repair work afterwards. An amendment passed in 1955, however, significantly expanded Corps functions and responsibilities as they applied to flood emergencies. Public Law 99, enacted by the Eighty-fourth Congress, provided authority for the army engineers to conduct operations on a broader scale, adding to their existing responsibilities flood emergency preparation and flood fighting. This meant the district no longer had to wait until a disaster struck before it could take corrective or remedial action. An amendment passed in 1962 further extended authority to encompass federally authorized hurricane or shore protection.[36]

Another legislative movement ran somewhat parallel to the evolution of Public Law 84-99, but carried different implications for the disaster operations of the Corps of Engineers. Ushered in during 1950, a national program made available federal assistance to disaster-stricken areas under Public Law 875, enacted by the Eighty-first Congress. The president was empowered to coordinate and direct the resources of federal agencies such as the Corps when local and state governments sought federal assistance. Under the provisions of the program, which has been updated by the Federal Disaster Relief Act of 1974, the Corps has been called upon to take emergency protective measures; to carry out



Emergency repairs to seawall at Port Arthur

emergency repair or replacement of dikes, levees, irrigation works, and drainage facilities; to clear debris and wreckage; to restore public facilities; and to attend to permanent restoration of flood-control works.[37] Technical assistance from the Corps has normally involved surveying the disaster area and furnishing reports and recommendations to the coordinating agency.

Since the mid-1950s, when the Weather Bureau began assigning female names to tropical hurricanes, several especially "lethal ladies" have visited the Texas Coast. In each case, the Corps has carried out the emergency flood-fighting functions authorized under Public Law 84-99 and has been called upon to furnish disaster relief assistance under Public Law 81-875 and its successor, Public Law 93-288.

Hurricane Carla grew out of an area of showers first noted in the western Caribbean on Sunday, September 3, 1961. A "superstorm" by most standards, Carla gradually intensified throughout the next week, until its wind circulation filled the entire Gulf of Mexico. Galveston District personnel were alerted to the large and menacing storm building up and moving across the Gulf. Continuous liaison was established with the

Waves smash into Galveston seawall during Hurricane Carla, September, 1961.

Weather Bureau, the army engineers providing support in tracking and studying the progress of the approaching monster.[38]

On Saturday, September 9, as hurricane warnings were hoisted along the Texas and Louisiana coastline, the district established a twenty-four-hour operations center on the third floor of the Galveston Post Office Building and placed its radio-telephone network in operation. Hourly reports from coastal field offices were transmitted to the Weather Bureau. As the tides began to rise, district vehicles were moved to the higher Gulf side of the island for safety.[39]

By Sunday, rising water covered the bay side of the island, severing the highway link to the Texas mainland and isolating the Post Office Building. After the remote control on its tide gauge in Galveston Channel was broken, the Weather Bureau used readings from the Corps of Engineers tide gauge at Fort Point. When this tide gauge went out also, district

personnel set up an emergency gauge at Fort Point and reported readings to the Weather Bureau by radio. Commercial power failed and the Corps radio net was maintained by emergency generators.[40]

Carla moved inland across the coast at Pass Cavallo about 3:00 P.M. on Monday, September 11. The eye of the tremendous storm spread 30 to 40 miles in diameter. While the Matagorda Bay area near Port O'Connor received the brunt of the storm with sustained winds of 153 miles per hour, gusts estimated up to 170 miles per hour, and storm surge elevations as high as 22 feet, the hurricane force winds radiated outward about 120 miles from the center. The storm was felt from the Rio Grande to Grand Island, Louisiana, with the stretch from Corpus Christi to the Sabine River suffering destruction by hurricane winds and abnormally high water levels. Early Tuesday morning, as district personnel were rescuing victims and transporting them to local hospitals, several tornadoes spun across Galveston Island, accounting for seven deaths and damaging or destroying 389 structures.[41]

During the four-day period from September 9-12, Galveston recorded a cumulative rainfall of 15.32 inches. Carla caused tides exceeding 20 feet in coastal bays, inundated 1,700,000 acres of coastal land, and disrupted normal activities in thirty-eight counties for four days. Damage tolls mounted to $408 million. Deaths from the storm totaled only thirty-two, largely due to the mass exodus of more than three-hundred thousand coastal residents.[42]

As the deadly storm began to dissipate, the Corps of Engineers organized and sent six hydrological survey teams and eleven damage survey teams into the stricken area. They completed their surveys in thirty days, canvassing 970 communities and traveling an aggregate distance of 45,000 miles. Meanwhile, district personnel inspected government equipment and facilities and all navigable waterways. Restoration of flood-control structures and various recovery operations were performed in accordance with the laws covering floods and disaster situations.[43]

The next major hurricane struck the southern tip of Texas on September 20, 1967, thirteen days after the first advisory had been issued. Moving inland, Hurricane Beulah was accompanied by torrential rains and 115 tornadoes, a staggering increase over Carla's record of 26 in 1961. Enormous amounts of rain caused flooding in every stream from the Lavaca River Basin to the Rio Grande Basin, accounting for the greatest proportion of Beulah's damages. Streams which normally have little or no flow became rampaging rivers. Beulah left a reported forty-four persons dead and thousands homeless, disrupting transportation, communication, and utility service throughout South Texas for weeks. Twenty-nine counties comprised the disaster area declared by the president.[44]

In addition to the hurricane-related duties that had become routine for the Galveston District, Corps personnel directed their major relief and recovery efforts after Beulah toward debris clearance, health and protective measures such as removing ponded water, and restoration of dikes and levees. They also furnished technical advice, preparing damage estimates and conducting final inspections of damaged public facilities restored under contracts for the Office of Emergency Planning (OEP).[45]

Col. Nolan C. Rhodes arrived in Galveston to assume the post of district engineer on August 1, 1970. He barely had time to unpack his suitcase before he was rudely initiated into operations for Hurricane Celia, which moved inland just north of Corpus Christi on the afternoon of August 3. Celia's distinguishing feature, savage winds with gusts estimated as high as 180 miles per hour, caused the major portion of destruction. The aftermath of the storm resembled more the effects of a tornado than of a hurricane. Thirteen lives were lost during this vicious storm and the metropolitan area of Corpus Christi suffered the greatest damages.[46]

Producing the largest amount of property damage of any storm to date — $467,311,000 worth — Hurricane Celia set the stage for extensive recovery activities by the army engineers. Called upon to direct a tremendous debris removal operation, they awarded the first contract providing for clearance of debris and broken glass in the downtown area of Corpus Christi on August 5, less than twenty-four hours after the disaster area was declared. Celia's devastation was so enormous that commercial activity could not be restored for six days.[47]

Within a week, all seven counties in the disaster area were under contract for removal of debris from streets, alleys, and other public property. On August 26, this operation reached its peak with 1,556 contractor personnel using 195 loaders and 785 trucks moving a total of 128,000 cubic yards. Three weeks after the storm, debris clearance from private property began.[48]

At the request of local authorities, the Corps of Engineers inspected many hazardous structures, recommending to OEP 1,061 demolition permits. Of these, OEP approved 938 which the engineers processed into forty demolition contracts.[49]

Less than three months later, on October 21, 1970, all debris removal operations were completed and the Corpus Christi Disaster Area Office was closed. This massive cleanup operation conducted by the Galveston District and OEP cost over $10 million.[50]

Experiences with hurricanes like Carla, Beulah, and Celia demonstrate how significantly disaster work of the army engineers has grown in recent years. Maintaining a posture of constant readiness, the Galveston District

today assumes a major responsibility for safeguarding the residents and property along its coast against both natural and "man-made" disasters.

Notes to Chapter 9

[1] Walter K. Henry, Dennis M. Driscoll, and J. Patrick McCormack, *Hurricanes on the Texas Coast* (Center for Applied Geosciences, College of Geosciences, Texas A&M University, 1975), p. 11; Definitions of hurricanes vary, generally specifying sustained wind speeds exceeding 64 to 65 knots, roughly 73 to 75 miles per hour, or more.

[2] John Edward Weems, *A Weekend in September* (New York: Henry Holt and Company, 1957), p. 17.

[3] Herbert Molloy Mason, Jr., *Death from the Sea* (New York: Dial Press, 1972), p. 74; H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 17.

[4] Mason, *Death from the Sea*, p. 74.

[5] H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 46; Mason, *Death from the Sea*, p. 82.

[6] H.R. Doc. 218, 83d Cong., 1st sess. (1953), p. 41; H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 46.

[7] H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 46.

[8] Albert B. Davis, Jr., *Galveston's Bulwark against the Sea: History of the Galveston Seawall* (Galveston: Corps of Engineers, 1974), pp. 1-2.

[9] H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 46. Table V on p. 61 presents recorded high-water elevations for the 1900 storm.

[10] The city election on September 10, 1901 was tantamount to a referendum on the new charter giving Galveston its new commission form of government. "Galveston's contribution to municipal reform . . . temporarily became the core of urban progressivism. The child of the great hurricane had grown to engulf the nation in a wave of structural change." Bradley R. Rice, "The Galveston Plan of City Government by Commission: The Birth of a Progressive Idea," *Southwestern Historical Quarterly* 78 (April 1975): 402, 408.

[11] Rpt., Board of Engineers to Board of Commissioners, City of Galveston, 25 January 1902, p. 1 (hereafter cited as *Robert Board Report*).

[12] *Geneses of the Corps of Engineers* (Fort Belvoir, Va.: Corps of Engineers Museum, 1966), p. 24.

[13] *Robert Board Report*, p. 10.

[14] Albert B. Davis, Jr., "History of the Galveston Seawall," in *Proceedings of Second Conference on Coastal Engineering*, ed. J. W. Johnson (Houston: Council on Wave Research, Southwest Research Institute, and Texas A&M Research Foundation, November 1951), pp. 270-72.

[15] Rivers and Harbors Act of June 13, 1902, ch. 1079, 32 Stat. 331; Act of April 28, 1904, ch. 1762, 33 Stat. 452; Act of June 30, 1906, ch. 3914, 34 Stat. 697; *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1906* (Washington, D.C.: Government Printing Office, 1906), pp. 428, 1351.

[16] Davis, "History of the Galveston Seawall," p. 272; H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 49.

[17] Davis, "History of the Galveston Seawall," pp. 274-75; H.R. Doc. 693, 66th Cong., 2d sess. (1920), pp. 49-52; H.R. Doc. 218, 83d Cong., 1st sess. (1953), p. 42.

[18] Davis, "History of the Galveston Seawall," p. 275.

[19] *Ibid.*

[20] H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 51.

[21] H.R. Doc. 1390, 62d Cong., 3d sess. (1913), p. 6.

[22] *Ibid.*

[23] Davis, "History of the Galveston Seawall," pp. 275-76.

[24] H.R. Doc. 693, 66th Cong., 2d sess. (1920), p. 29; Davis, "History of the Galveston Seawall," p. 276; The 9,860 feet of San Jacinto extension built by the United States cost the federal government $2,289,213. H.R. Doc. 173, 81st Cong., 1st sess. (1949), p. 18.

[25] Davis, *Bulwark against the Sea*, pp. 18-19.

[26] *Report of Proceedings and Findings of Board of Officers Appointed to Investigate Sinking of U.S. Dredge "Galveston" July 27, 1943* (Galveston: U.S. Engineer Office, 1943), p. 4 (hereafter cited as *Sinking of Dredge "Galveston"*).

[27] *Ibid.*, pp. 5, 10, Exhibit E-7, Exhibit F.

[28] *Ibid.*, Exhibit F & p. 6.

[29] *Ibid.*, p. 6.

[30] *Ibid.*, pp. 6-7.

[31] *Ibid.*, p. 7, Exhibit E-3, Exhibit E-4.

[32] *Ibid.*, p. 8; Interview with Herbert Schmidt.

[33] *Sinking of Dredge "Galveston,"* p. 9; *Galveston Daily News*, 12 October 1943.

[34] *Reports and Correspondence on the Texas City Disaster April 16-17, 1947* (Galveston: Corps of Engineers, 1947). The account of this disaster is based on pp. 1-4 of this report.

[35] Flood Control Act of August 18, 1941, 33 U.S.C.A. § 701 (1970).

[36] Act of June 28, 1955, ch. 194, 69 Stat. 186, amending 33 U.S.C.A. § 701n (1970); Flood Control Act of October 23, 1962, Pub. L. No. 87-874, tit. II, § 206, 76 Stat. 1194, amending 33 U.S.C.A. § 701n (1970).

[37] Act of September 30, 1950, ch. 1125, 64 Stat. 1109; Disaster Relief Act of May 22, 1974, Pub. L. No. 93-288, 88 Stat. 143 (codified in scattered sections of 42 U.S.C.A.).

[38] *Report on Hurricane Carla 9-12 September 1961* (Galveston: Corps of Engineers, 1962), pp. 2, 4.

[39] *Ibid.*, pp. 4-5.

[40] *Ibid.*, p. 5.

[41] *Ibid.*, pp. 2-3, 10; *Disaster Activities under Public Law 875, 81st Congress: Hurricane "Carla" After-Action Report* (Galveston: Corps of Engineers, 1962), p. 1-1 (hereafter cited as *"Carla" After-Action Report*).

[42] *Report on Hurricane Carla*, pp. 20, ix, 3.

[43] *Ibid.*, p. 7; *"Carla" After-Action Report.*

[44] *Report on Hurricane "Beulah" 8-21 September 1967* (Galveston: Corps of Engineers, 1968), Foreword, pp. 2-5.

[45] *After-Action Report on Hurricane "Beulah" 8-21 September 1967* (Galveston: Corps of Engineers, 1968), p. 3.

[46] *Report on Hurricane "Celia" 30 July-5August 1970* (Galveston: Corps of Engineers, 1971), Foreword.

[47] *Ibid.*, tables 3 & 4; "After-Action Report on Hurricane 'Celia' 30 July-5 August 1970" (Typed report, n.d.), p. 13.

[48] *Ibid.*, pp. 13, 18.

[49] *Ibid.*, p. 14.

[50] *Ibid.*, p. 20.